



IGCC / Clean Coal Technology

•Types of Coal Generation

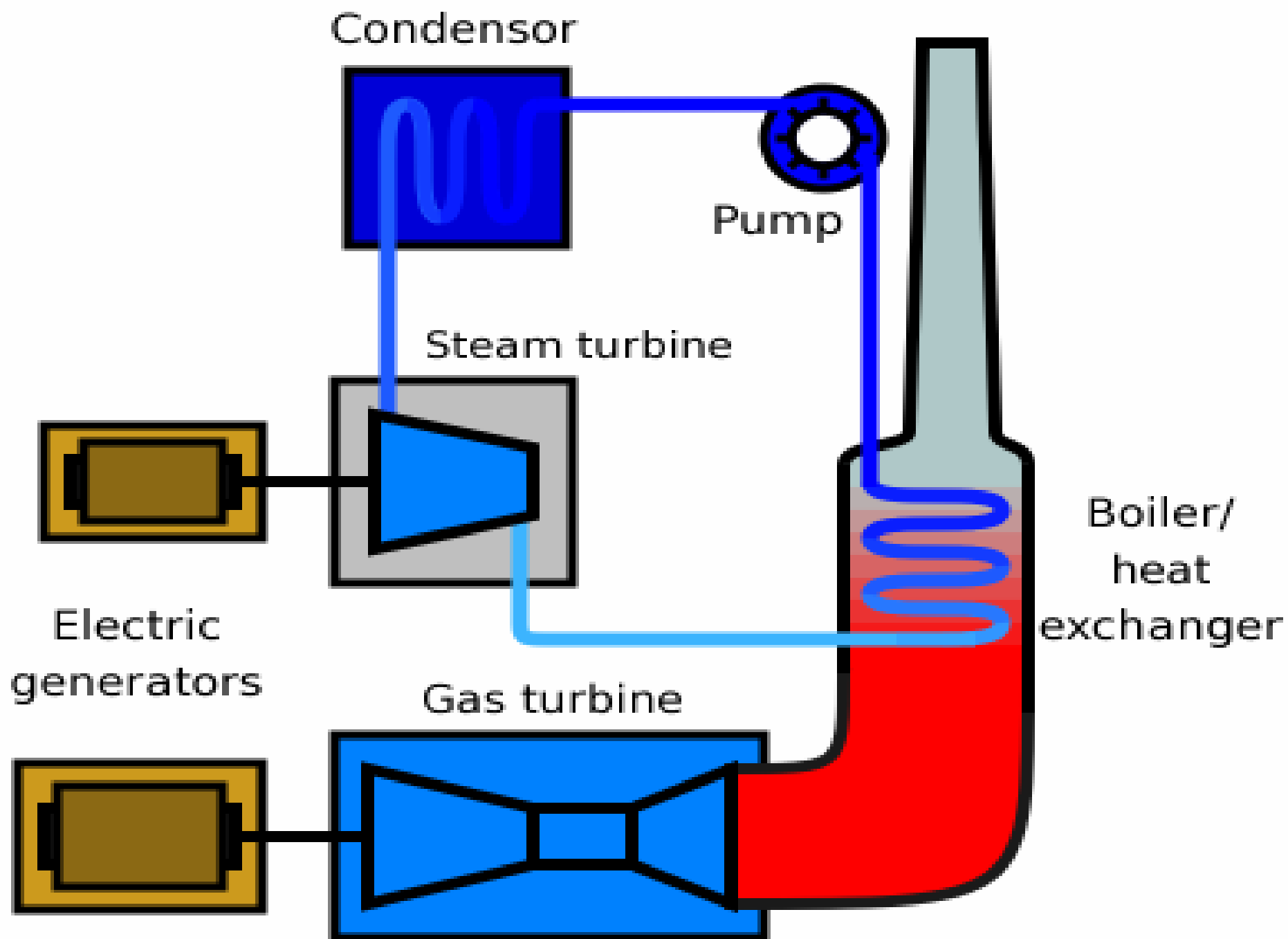
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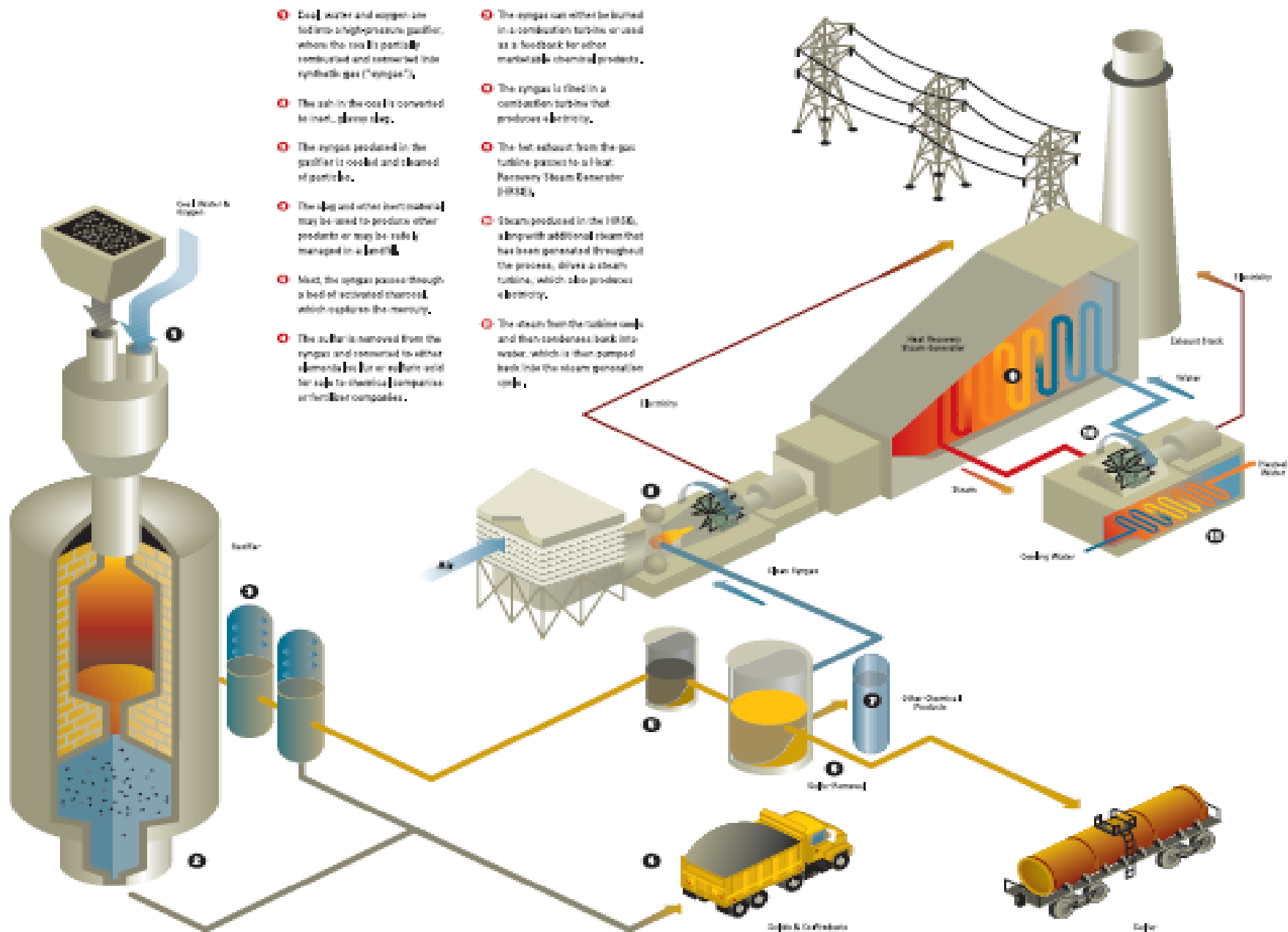
- **Pulverized coal (PC):** Finely ground coal is burned to make steam and then flue gases are cleaned up; there are more than 1000 such “conventional coal” plants in the U.S.
- **Very high-temperature versions of PC** employ supercritical (SC) steam, and even higher use ultra-supercritical (USC)
- **Circulating fluidized-bed combustion (CFBC or FBC):** Larger coal pieces are “fluidized” by combustion air and entrained with a “sorbent” such as limestone to remove SO₂

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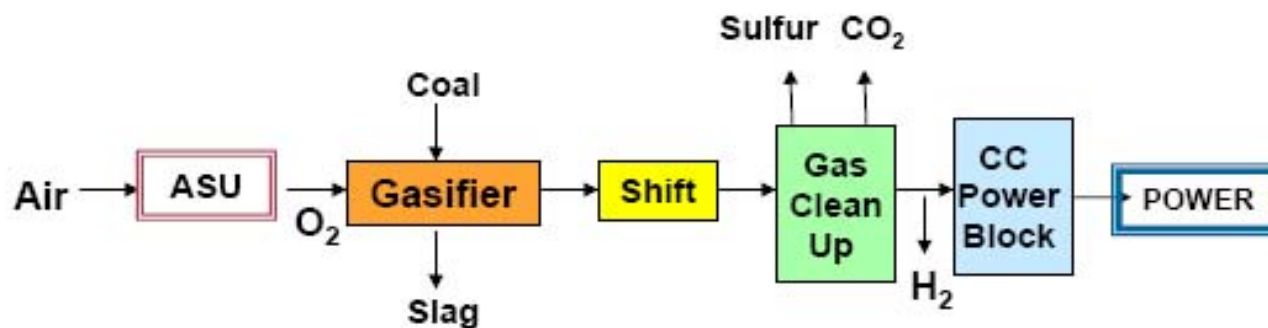
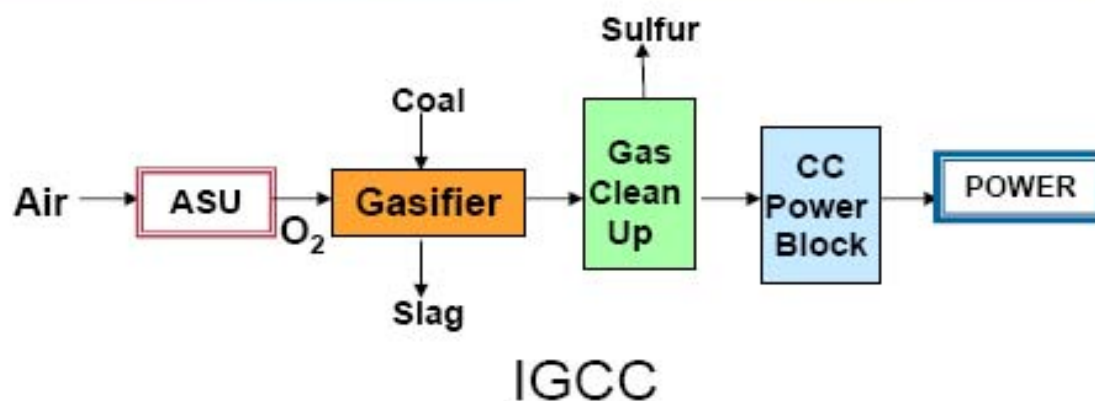
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- **Gasification** of coal involves reaction with oxygen and heat/steam to produce a “synthesis gas” containing CO, hydrogen, and (sometimes) methane. [If] The gas is cleaned and then burned in a gas turbine with the exhaust heat used to make steam; such plants are “integrated gasification combined cycle” (IGCC).





IGCC With and Without CO₂ Removal



H₂ & CO₂ (e.g., FutureGen, BP Carson on Coke)

What About CO₂?

- Higher efficiency designs inherently produce less CO₂ per kWh
- **Neither IGCC nor pulverized coal inherently captures CO₂ and it takes additional energy and cost to capture and store CO₂**
- US and world efforts are aimed at developing better options for high efficiency generation and understanding how to economically capture and safely store CO₂
- CO₂ storage viability is key

Today - Existing Coal-based IGCCs



Puertollano (Spain)



Wabash (Indiana)



Polk (Florida)



Buggenum (Netherlands)

Coal Based IGCC Plants

Project/ Location	Combustion Turbine	Gasification Technology	Net Output MW	Start-Up Date
Wabash River, IN	GE 7 FA	E Gas (ConocoPhillips)	262	Oct 1995
Tampa Electric, FL	GE 7 FA	Texaco (GE Energy)	250	Sept 1996
Nuon (Formerly Demkolec) Buggenum Netherlands	Siemens V 94.2	Shell (Offered jointly with Krupp- Uhde)	253	Jan 1994
ELCOGAS Puertollano Spain	Siemens V 94.3	Prenflo (Offered jointly with Shell)	300	Dec 1997

US IGCC/Gasification

(Some Projects in Development)

Name/Owner	Location	MW	Technology	Other Products	Notes/Status
AEP	OH, W.Va, Ky	600	GE		FEED w/GE
Cinergy	IN	600	GE		FEED w/GE
Excelsior	Mesaba, MN	600	COP E-Gas		CCPI 2
Steelhead	Illinois	615	COP E-Gas	95 MSCFD SNG	FEED
Energy NorthWest	Washington	600			Study with COP E-Gas
WMPI	Pennsylvania	60	Shell	5000 bpd F-T Diesel	CCPI 1, Culm (waste coal)
SoCo/Orlando	Florida	285	Air-blown KBR		CCPI 2, PRB
Royster Clark/Rentech	Illinois	60	COP E-Gas	1000 tpd NH ₃ 2000 bpd F-T	FEED
ERORA	Illinois	550	GE	Chemicals?	FEED Eastman
BP/Edison Mission	California	500		Hydrogen. CO ₂ for EOR	Pet Coke Announcement
Global	Lima, OH	530	COP E-Gas		Earth moving

Coal-Based IGCC Status

- **Limited experience:**
 - Two operating US plants
 - Two operating European plants
- **Capital cost concerns:**
 - Industry estimates - costs higher than PC plants
 - Uncertainties with costs associated with guaranties, warranties, availability, etc.
- **Availability concerns:**
 - 80% maximum availability at two existing single-train US plants
 - Availability expected to improve with higher equipment redundancy (spare gasifier)





Questions & Next Steps?